

CLAIMS

1. A display apparatus for providing a grayscale display based on a video signal with a grayscale level using
5 a sub-field method, comprising:

a display panel that is composed of a plurality of areas each including first, second, third, and fourth pixels that are vertically and horizontally adjacent to one another; and
a grayscale display unit that stores first, second,
10 third, and fourth tables that include a plurality of first, second, third, and fourth emission patterns corresponding to said respective first, second, third, and fourth pixels in each area, and selects first, second, third, and fourth emission patterns corresponding to said first, second, third,
15 and fourth pixels, respectively, from said first, second, third, and fourth tables based on the grayscale level of the video signal, so as to provide a grayscale display by causing said first, second, third, and fourth pixels in each area of said display panel to emit light or not for each sub-field
20 based on the selected first, second, third, and fourth emission patterns, wherein

combination patterns of emissions and non-emissions in predetermined sub-fields of said plurality of sub-fields are different among said first, second, third, and fourth
25 emission patterns,

said first pixel and said second pixel are arranged in one diagonal positions while said third pixel and said fourth pixel are arranged in another diagonal positions in each area, and

5 for each grayscale level, a grayscale value represented by each of said first emission pattern and said second emission pattern is lower than an average of grayscale values represented by said first, second, third, and fourth emission patterns, while a grayscale value represented by each of said
10 third emission pattern and said fourth emission pattern is higher than said average.

2. The display apparatus according to claim 1, wherein said plurality of sub-fields have different weights
15 from one another, and

said predetermined sub-fields include, from a sub-field with the maximum weight to a sub-field with the minimum weight arranged in order of decreasing weight, a predetermined number of sub-fields starting from a sub-field with the
20 greatest weight of the sub-fields in which a pixel emit light.

3. The display apparatus according to claim 1, wherein in two or more emission patterns of said first, second, third, and fourth emission patterns, said combination

patterns of said predetermined sub-fields are the same between adjacent grayscale levels.

4. The display apparatus according to claim 1, further comprising a detector that detects a degree of a false contour noise in an image displayed on said display panel, wherein said grayscale display unit further stores fifth, sixth, seventh, and eighth tables that include a plurality of fifth, sixth, seventh, and eighth emission patterns corresponding to said first, second, third, and fourth pixels, respectively, and selects either of a set of said first table to said fourth table or a set of said fifth table to said eighth table based on a result of detection by said detector, and when selecting the set of said fifth table to said eighth table, said grayscale display unit selects fifth, sixth, seventh, and eighth emission patterns corresponding to said respective first, second, third, and fourth pixels in each area from the selected fifth, sixth, seventh, and eighth emission patterns based on the grayscale level of the video signal, so as to provide a grayscale display by causing said first, second, third, and fourth pixels in each area of said display panel to emit light or not for each sub-field based on the selected fifth, sixth, seventh, and eighth emission patterns,

some of combination patterns of emissions and non-emissions in said predetermined sub-fields are the same among said fifth, sixth, seventh, and eighth emission patterns, and

5 for each grayscale level, a grayscale value represented by each of said fifth emission pattern and said sixth emission pattern is lower than an average of grayscale values represented by said fifth, sixth, seventh, and eighth emission patterns, while a grayscale value represented by
10 each of said seventh emission pattern and said eighth emission pattern is higher than said average.

5. The display apparatus according to claim 1, wherein said grayscale display unit includes:

15 a dither value generator that stores differences between each grayscale level and grayscale values represented by said respective first, second, third, and fourth emission patterns as first, second, third, and fourth dither values, and outputs first, second, third, and fourth dither values
20 corresponding to the grayscale level of the video signal;

 a coefficient adder that adds each of said first, second, third, and fourth dither values generated by said dither value generator to the grayscale level of the video signal; and

a driver that stores said first, second, third, and fourth tables, and selects first, second, third, and fourth emission patterns from said first, second, third, and fourth tables based on the result of addition by said coefficient adder, so as to cause said first, second, third, and fourth pixels in each area of said display panel to emit light or not for each sub-field based on the selected first, second, third, and fourth emission patterns.

10 6. The display apparatus according to claim 1, further comprising a diffusion device that diffuses spatially and/or temporally an error in space and/or time between the grayscale level of the video signal and the average of the grayscale values represented by said respective first, second, third, and fourth emission patterns to the video signal when the
15 grayscale level of the video signal and the average of the grayscale values represented by said respective first, second, third, and fourth emission patterns are different.

20 7. A display method for displaying grayscale on a display panel based on a video signal with a grayscale level using a sub-field method,

 said display panel being composed of a plurality of areas each including first, second, third, and fourth pixels
25 that are vertically and horizontally adjacent to one another,

said first pixel and said second pixel being arranged in one diagonal positions while said third pixel and said fourth pixel being arranged in another diagonal positions in each area, said method comprising the steps of:

5 storing first, second, third, and fourth tables that include a plurality of first, second, third, and fourth emission patterns corresponding to said first, second, third, and fourth pixels, respectively;

 selecting first, second, third, and fourth emission
10 patterns corresponding to said respective first, second, third, and fourth pixels in each area from said first, second, third, and fourth tables based on the grayscale level of the video signal; and

 displaying grayscale by causing said first, second,
15 third, and fourth pixels in each area of said display panel to emit light or not for each sub-field based on the selected first, second, third, and fourth emission patterns, wherein

 combination patterns of emissions and non-emissions in predetermined sub-fields of said plurality of sub-fields are
20 different among said first, second, third, and fourth emission patterns, and

 for each grayscale level, a grayscale value represented by each of said first emission pattern and said second emission pattern is lower than an average of grayscale values
25 represented by said first, second, third, and fourth emission

patterns, while a grayscale value represented by each of said third emission pattern and said fourth emission pattern is higher than said average.

5 8. The display method according to claim 7, wherein said plurality of sub-fields have different weights from one another, and

 said predetermined sub-fields include, from a sub-field with the maximum weight to a sub-field with the minimum weight
10 arranged in order of decreasing weight, a predetermined number of sub-fields starting from a sub-field with the greatest weight of the sub-fields in which a pixel emit light.

 9. The display method according to claim 7, wherein
15 in two or more emission patterns of said first, second, third, and fourth emission patterns, said combination patterns in said predetermined sub-fields are the same between adjacent grayscale levels.

20 10. The display method according to claim 7, further comprising the steps of:

 detecting a degree of a false contour noise in an image displayed by said display panel;

 storing fifth, sixth, seventh, and eighth tables that
25 include a plurality of fifth, sixth, seventh, and eighth

emission patterns corresponding to said first, second, third, and fourth pixels, respectively;

selecting either of a set of said first table to said fourth table or a set of said fifth table to said eighth table
5 based on the result of detection of the degree of a false contour noise;

when the set of said fifth table to said eighth table is selected, selecting fifth, sixth, seventh, and eighth emission patterns corresponding to said respective first,
10 second, third, and fourth pixels in each area from said selected fifth, sixth, seventh, and eighth tables based on the grayscale level of the video signal; and

displaying grayscale by causing said first, second, third, and fourth pixels in each area of said display panel
15 to emit light or not for each sub-field based on said selected fifth, sixth, seventh, and eighth tables, wherein

some of combination patterns of emissions and non-emissions in said predetermined sub-fields are the same among said fifth, sixth, seventh, and eighth emission
20 patterns, and

for each grayscale level, a grayscale value represented by each of said fifth emission pattern and said sixth emission pattern is lower than an average of grayscale values represented by said fifth, sixth, seventh, and eighth
25 emission patterns, while a grayscale value represented by

each of said seventh emission pattern and said eighth emission pattern is higher than said average.

11. The display method according to claim 7, wherein
5 said step of displaying grayscale includes the steps of:
storing differences between each grayscale level and grayscale values represented by said respective first, second, third, and fourth emission patterns as first, second, third, and fourth dither values;

10 outputting first, second, third, and fourth dither values corresponding to the grayscale level of the video signal;

adding each of said generated first, second, third, and fourth dither values to the grayscale level of the video
15 signal;

storing said first, second, third, and fourth tables;

selecting first, second, third, and fourth emission patterns from said first, second, third, and fourth tables based on the result of addition; and

20 causing said first, second, third, and fourth pixels in each area of said display to emit light or not for each sub-field based on the selected first, second, third, and fourth emission patterns.

12. The display method according to claim 7, further comprising the step of diffusing spatially and/or temporally an error between the grayscale level of the video signal and the average of the grayscale values represented by said
5 respective first, second, third, and fourth emission patterns to the video signal when the grayscale level of the video signal and the average of the grayscale values represented by said respective first, second, third, and fourth emission patterns are different.